A Method for embedding an ***air dielectric*** transmission line in a printed circuit board by suspending a signal trace on a supporting dielectric layer between conductive planes, said planes having a recession, forming an air channel, centered on said signal trace.

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority from U.S. Provisional Application No. 60/391,021 filed on Jun. 25, 2002 for Method for making an air dielectric transmission line in a printed wiring board by Ronald Brooks Miller.

FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

None

JOINT RESEARCH AGREEMENTS

None

INCORPORATION-BY-REFERENCE OF MATERIAL ON COMPACT DISK.

None

BACKGROUND OF THE INVENTION

[0051] 1. Field of the Invention.

This invention is used in the field of printed circuit board fabrication used for interconnection of electronic components in the electronic and computer fields.

[0052] The present invention relates to a PCB design for application in analog and high speed digital applications using a air-dielectric suspended substrate. This will allow improved signal integrity, lower bit-error-rate, better eye pattern and higher-speed data signals.

[0053] 2. Description of the Related Art--the Need

[0054] Electronic data rates are ever increasing. Today we have

gigahertz data rates and looking to terahertz data rates in the future. Also, size reduction and cost reduction is constantly being pressed.

[0055] Some of the technical problems associated with designing and fabricating reliable interconnect of devices at these frequencies are:

[0056] 1. High-Frequency attenuation

[0057] 2. Degradation of state transitions(dispersion of signal edge)

[0058] 3. Delay in the signal from one place to another

[0059] 4. Eye pattern distortion and closure

[0060] 5. Data errors.

[0061] 6. Group-delay

[0062] 7. Reflections

[0063] These problems can be caused by the following factors

[0064] 1. The dielectric loss tangent

[0065] 2. Frequency dependency of loss tangent

[0066] 3. The dielectric Constant

[0067] 4. Frequency dependency of dielectric constant

[0068] 5. Skin effect

[0069] 6. Cross-talk

[0070] 7. Impedance variations

[0071] 8. Frequency dependency of impedance variations(stubs etc.)

In order to reduce some of these problems, exotic expensive materials including Teflon are presently being used but these drive

the costs up significantly and do not come to the optimum solution.

BRIEF SUMMARY OF THE INVENTION

Construction

The primary novelty and value of the patent is in the structure of the area surrounding the signal conductor. Whereas standard printed circuit boards are made as rigid as possible by the exclusion of air, this invention uses air in a honey-comb structure to replace most of the dielectric.

A thin dielectric sheet with a signal conductor is sandwiched between two metal plates. The metal plates are shaped to contact the dielectric sheet only in areas away from the signal conductor. The metal plates have indentations around the signal trace to allow an air gap between the plate and the signal trace.

The top and bottom metal plates are both shaped to provide this air gap between the dielectric sheet in the area around the signal conductors.

The two shaped metal plates may also be fabricated as a spacer and as a separate sheet which are bonded. The spacers are located above and below the dielectric layer and separate the outer conductive sheet from the thin dielectric sheet. These spacers have air channels above and below the signal conductor so that the dielectric between the signal conductor and the conductive plane is primarily air.

Advantages:

This patent uses air as the primary dielectric around the signal traces, achieving all the performance advantages of an air dielectric within a printed circuit board, achieving data rates of 10 Gbs and higher without distortion, or degradation of the signal, reduces high-frequency attenuation, improves rise-time and fall-time, reduces delay, improves eye-pattern, reduces data errors, reduces group delay, reduces reflections, reduces cross-talk, and improves the fidelity of the signals.

This is accomplished inside a printed circuit board using processing techniques already being used by printed circuit fabrication shops and in common usage for other products.

Costs are reduced by using inexpensive materials.

BRIEF DESCRIPTION OF THE DRAWINGS

[0106] FIG. 1 is an expanded orthogonal view of one layer with three parallel lines intended to help in visualizing how the signal trace is suspended in air riding on the dielectric carrier. Note that the top channels are mirror image of the bottom channels so that when the assembly is laminated the trace is in a shielded enclosure.

[0107] The metal plates have the metal removed, most likely by milling or forming or some other method depending on cost.

[0108] Also, note that the dielectric carrier layer is thin and provides a virtual short due to the capacitance from one plate to the other.

[0109] FIG. 2 is an end-on view of a single air dielectric trace in the metal channels. FIG. 2 shows the basic structure of claim 1 with (1) a top metal plate, (2) a central dielectric layer, and (2) a bottom metal plates. The conductive trace on the central dielectric sheet is located in the middle of the air channel in the two metal plates.

[0110] FIG. 2A is an end-on view of a differential pair in air dielectric

[0111] FIG. 2B is an end-on view of a 4 signal data-bus in air dielectric.

[0103] FIG. 3 is similar to FIG. 2 in all respects except that the top metal plate is made up of a top plane or shield, and a spacer plate. Similarly, the bottom metal plate is made up of a bottom plane and a bottom spacer.

[0113] An adhesive may be either applied to the metal or may be a sheet.

[0114] The advantage of this method that the spacing from signal trace to the top and bottom plate is precisely determined by the

thickness of the spacer layer, at very little cost but provides very accurate impedance control.

[0115] FIG. 4 illustrates:

[0116] The stacking of multiple layers of air-dielectric assembly.